

Evidence for the existence of culture in captive chimpanzees (*Pan troglodytes*)? M.HOOK, R.STAVISKY, S. LAMBETH, J.PERLMAN, S.SCHAPIRO, and M. BLOOMSMITH. UT MD Anderson Cancer Center, Bastrop, TX 78602

Many researchers accept that animals are capable of social learning. However, the concept that animals use social learning to propagate culture, is not widely examined. This is due in part to the belief that culture is a uniquely human phenomenon. Recent findings by Whiten *et al.*, (1999), that populations of wild chimpanzees (*Pan troglodytes*) differentially express tool use, foraging, and display behaviors, suggest that cultural variance may exist in this species. The aim of our study was to apply the techniques of Whiten *et al.*, (1999) with captive chimpanzees. We examined the expression of abnormal behaviors in eight groups of captive chimpanzees at one facility. Nash *et al.* (1999), suggest that abnormal behaviors expressed by captive chimpanzees may represent learned behaviors, and as such, a foundation of culture.

The behaviors examined included; coprophagy, feces smearing, hair pulling, regurgitation, rocking, urophagy, repetitive body movements, self-slap, and spitting. We characterized groups on the basis of the percentage of individuals per group exhibiting these behaviors. The following categories were used to denote participation; Absent (0%), Few (1-20%), Some (21-40%), Half (41-60%), Habitual (61-80%), Customary (81-100%). The effects of age, sex, and environment were also examined. A minimum of 30 hours of scan data were collected from each group.

Environmental differences, including enclosure design, enrichment and size, significantly influenced the expression of abnormal behaviors;  $t_{[8]} = 3.29$ ,  $p = 0.01$ . Sex was also a significant factor; more females displayed abnormal behavior ( $t_{[8]} = -3.89$ ,  $p = 0.005$ ), while age had no effect. When we controlled for sex and environment, we found that profiles of abnormal behavior differed across groups. For example, spitting was present as "Half" in one group, while "Absent" in others. Such differences suggest that patterns of abnormal behavior may be appropriate for assessing cultural variance in captive chimpanzees.

A study of discrete skeletal traits in the skeletal population from Albany Mounds, Illinois. K.L. HORNBACH, Northern Illinois University, DeKalb, IL 60115

The Middle Woodland Albany Mounds, Illinois skeletal sample ( $n = 204$ ) is an ideal sample on which to perform a discrete trait analysis since the sample has not previously been analyzed. Frequencies and types of discrete traits observed in a population have been used to interpret biological relationships. This study focused on 65 cranial and post-cranial discrete traits in an attempt to interpret biological

variability within the population sample.

An ANOVA analysis found low levels of variation in the sample for post-cranial traits while cranial traits displayed higher levels of variation in the sample. The remaining analysis thus focused on the cranial traits alone. A cluster analysis using SPSS-PC identified two groups within the sample. These clusters each contained both males and females. Sex was not a significant factor ( $p > 0.01$ ) in defining the clusters.

Within the male group, cluster analysis broke down the group further into two additional groupings. Males showed 17 traits describing the group with 15 significant traits ( $p > 0.05$ ). Among the females alone two clusters were identified. In the female group 15 traits were found to address the group's variability with 11 significant traits ( $p > 0.05$ ).

Results of the insignificant role of the sex trait in the cluster analysis suggest males and females were from the same biological populations and have implications for social and cultural practices that affect variability.

Mitochondrial DNA analysis of Spider Monkeys: a non-invasive technique. K.A. HORSBURGH<sup>1</sup>, E. MATISOO-SMITH<sup>1</sup>, and J.S. ALLEN<sup>2</sup>. <sup>1</sup> Department of Anthropology, University of Auckland, Private Bag 92019, Auckland, New Zealand. <sup>2</sup> Departments of Anthropology and Neurology, University of Iowa, Iowa City, Iowa 52246 USA

The value of studies of genetic variability in non-human primates is without question. However, there is a growing need for the combination of genetic approaches with field based research, particularly when addressing issues of primate behavior and ecology. Blood and other tissue samples required for genetic analyses are difficult to obtain in most field situations. Even when animals can be trapped for sample collection, the resulting stress is not only potentially hazardous to the animals (and often the collector), it may also affect the behavior and the biology of the individual and the group to which it belongs. DNA obtained from feces provides an ideal sampling alternative for field based studies that include a genetic component. Since the initial paper describing excremental analysis by PCR (Hoss *et al* 1992), the approach has been used on a range of animals, including a number of primate species (Gerloff *et al.* 1995, Constable *et al.* 1995, Launhardt *et al.* 1998). However, as far as we can tell, this approach has not been reported for New World Monkeys. In addition, most studies describe a collection protocol which involves freezing, or freeze drying samples, or storage immediately in ethanol. Here we report on a non-invasive method for genetic analyses using fecal material obtained from a captive population of Spider Monkeys, *Ateles geoffroyi*.

Most importantly, we show that fecal samples can be easily collected and stored for extended periods of time without refrigeration prior to laboratory analysis, making this approach ideal for field based studies.

Political economy of forced migration and sex ratio. J.E. HOWSON, Howard University, Box 987, Washington, DC, 20059, S.K. GOODE-NULL, University of Massachusetts, Amherst, M.L. BLAKEY, E.L. BROWN, Howard University, and L.M. RANKIN-HILL, University of Oklahoma, Norman, OK.

New York's African Burial Ground is an 18th century cemetery for enslaved Africans, of which more than 400 skeletal remains have undergone extensive study. An interdisciplinary interpretation sex ratios is reported.

The sex ratios of the Africans of colonial New York City are significant because of the complex interaction of historically-specific political and economic factors involved. Census data for 18th century New York City show proportionally more females than males for most years, with the lowest sex ratios following dates of rebellion (1712 and 1741). We suggest that sex ratio is partly a function of social control. Years of high importation/forced migration of women and girls also correspond to proportionally high importation directly from the African continent instead of via the Caribbean, thus lowering prices for humans. The particular labor needs of the city might also affect the importation of women and children.

Sex estimation of the skeletal population indicates, on the contrary, far more men than women. We suggest that the missing females are among the unsexed subadults. A modification of the Hunt and Gleiser sexing method was used on 24 subadults showed ratios ranging from 7:1 to 11:1 females:males under 5 years of age. Sex ratios shift dramatically in favor of males 10 years of age and older. Also, cemetery returns available for a second African Burial Ground in New York for 1801-1814, demonstrate a similar pattern of high mortality and representation of girls among 53 named child burials. Social conditions do not promote survival of female infants and young children, raising important issues of infanticide and/or gender-specific neglect during urban enslavement.

Estimating gene flow within and between Native South American populations. K.L. HUNLEY and D.A. MERRIWETHER, Department of Anthropology, University of Michigan, Ann Arbor, MI 48109.

Anthropologists modeling prehistoric demographic change in humans and their

ancestors have been forced to rely on limited ethnographic information in order to estimate integral demographic and population genetic parameters (e.g., gene flow), either because few data exist, or because there are no un-contacted or non-marginalized traditional populations left from which to extract this important information. For example, many models requiring estimates of gene flow in small scale societies essentially rely on the results of a single ethnographic account (e.g. Tindale, 1940, 1974).

Here, we quantify gene flow within a subdivided population that had experienced little outside contact at the time of sampling, the Yanomami, a now well studied population inhabiting rain forests in Brazil and Venezuela who subsist predominantly through slash and burn agriculture. Using 30 autosomal STR's from approximately 200 individuals in seven villages in Brazil, we provide an accurate estimate of within population gene flow. We also provide preliminary estimates of between population gene flow by quantifying this parameter between these Yanomami villages and one adjacent Native American population, the Makiritare of southern Venezuela.

Late Pleistocene circum-Mediterranean population interaction: evidence from the Tangier (Morocco) subadult fossil maxilla. V. HUTCHINSON, Dept. Anthropology, Northern Illinois University, DeKalb, IL, 60115.

The recent controversy concerning the taxonomic affinities of the Tangier subadult maxilla is indicative of the continuing questions surrounding circum-Mediterranean human population interaction during the late Pleistocene. Senyurek (1940), and Myster and Smith (1990), have concluded that this fossil is distinct from modern humans and displays certain morphometric similarities to Neanderthals. Conversely, Minugh-Purvis (1993) states that the morphology of this maxilla falls within the range of modern humans.

The present study has compared the Tangier maxilla to an augmented (n=92) and more age-specific (aged 7-11 years) sample of modern human subadults, Neanderthal subadult specimens, and a sample of late Pleistocene north Africans in an effort to address this controversy. Morphologically this specimen shows features distinct from all maxillae in the modern and north African samples. The following similarities to Neanderthals were observed: lack of a canine fossa, an oblique inferior margin and retreating trajectory of the zygomatic root, and an inflated maxillary sinus relative to tooth size. Metrically this specimen, considered to be about nine years old at time of death, falls out of the range of modern human subadults in terms of absolute size and in certain indices of maxillary robusticity.

Although fragmentary, and precluding definitive assignment to a specific taxon, the similarities of the Tangier maxilla to Neanderthals are striking. The results of this study indicate that

this fossil is distinct from modern human sub-adults and displays similarities to Neanderthals. Keita (1990) also has noted European and African features in early holocene north Africans. Taken together, the possibility of interaction between European and African populations in the late Pleistocene cannot be discounted.

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Jaw-muscle recruitment patterns during mastication in anthropoids and prosimians. W.L. HYLANDER<sup>1</sup>, M.J. RAVOSA<sup>2</sup>, C.F. ROSS<sup>3</sup>, C.E. WALL<sup>1</sup> and K.R. JOHNSON<sup>1</sup>. <sup>1</sup>Dept. of Biological Anthropology & Anatomy, Duke University, Durham, NC 27710; <sup>2</sup>Dept. of Cell and Molecular Biology, Northwestern Medical School, Chicago, IL 60611; <sup>3</sup>Dept. of Anatomical Sciences, State University of New York @ Stony Brook, NY 11794.

The purpose of this study is to test the hypothesis that symphyseal fusion in anthropoids is due mainly to balancing-side jaw muscle forces.

Electromyographic (EMG) activity of the left and right superficial and deep masseters were recorded and analyzed in baboons, macaques, owl monkeys, and thick-tailed galagos. The masseter was chosen for analysis because in the frontal projection its superficial portion exerts force primarily in the vertical (dorsoventral) direction, whereas its deep portion has a relatively larger component of force in the transverse direction.

The symphyseal fusion-muscle recruitment hypothesis predicts that unlike anthropoids, galagos develop bite force with relatively little contribution from their balancing-side jaw muscles. Thus, compared to galagos, anthropoids recruit a larger percentage of force from their balancing-side muscles. If true, this means that during forceful mastication, galagos have working-side/balancing-side (W/B) EMG ratios that are relatively large, whereas anthropoids have W/B ratios that are relatively small. In addition, the symphyseal fusion-muscle recruitment hypothesis predicts that unlike anthropoids, galagos do not exhibit the deep masseter firing pattern associated with wishboning of the mandibular symphysis.

The EMG data indicate that galagos have the largest average W/B ratios for both the superficial and deep masseters. Of these ratios, however, the only significant difference between thick-tailed galagos and anthropoids is associated with the deep masseter. Furthermore, the analysis of masseter firing patterns indicates that whereas the anthropoids exhibit the deep masseter firing pattern associated with wishboning of the mandibular symphysis, galagos do not exhibit this firing pattern.

Thus, both the analysis of the W/B EMG ratios and the muscle firing pattern data support the hypothesis that symphyseal fusion and transversely-directed muscle force in anthropoids are functionally linked. This in turn supports the hypothesis that the evolution of symphyseal fusion in anthropoids is an adaptation to strengthen the symphysis so as to counter increased wishboning stress during forceful unilateral mastication.

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Ontogenetic variation in scapular form in African apes. S.E. INOUE. The National College of Chiropractic, Lombard, IL 60148 and A.B. TAYLOR, Department of Physical Therapy, Samuel Merritt College, Oakland, CA 94609.

Differences in scapular morphology between the African apes have been documented by a number of investigators. While field studies have revealed differences in locomotor behavior between *Pan* and *Gorilla*, and even among taxa within each genus, the adaptive significance of these morphological features remains poorly understood. We investigate scapular form in *Pan* and *Gorilla* and assess the degree of morphological variability both within and between species/- subspecies of African apes.

We compared scapular form in ontogenetic series of *G.g. gorilla* (n = 84), *G.g. beringei* (n = 20), *P.t. troglodytes* (n = 33), *P.t. schweinfurthii* (n = 40), *P.t. verus* (n = 38) and *P. paniscus* (n = 27). We measured a suite of scapular variables, including some that have more recently been shown to discriminate among anthropoid primates (Larson, 1995).

We ran a PCA on scapular length and breadth, spine length, and supra- and infra-spinous fossae lengths. The first component accounts for 97.1% of the variation and distributes gorillas and chimps according to overall size. The second component accounts for only 2.2% of the variation and does not effect a separation between these taxa. We then ran a PCA on a suite of additional scapula variables. Again, the first component accounts for 92.6% of the variation and distributes the African apes according to overall size. However, the second component clearly separates gorillas from chimps, with a downward transposition in data scatters from *Pan* to *Gorilla*. ANCOVA confirms these results. Infrapinuous fossa expansion, lateral expansion of the subscapular fossa and superior border length load most strongly and thus drive the separation between *Pan* and *Gorilla*. Furthermore, some of these same variables effect a separation within *Pan*, particularly between *P.t. verus* and *P. paniscus*. These differences may be related to variation in locomotor behavior among these taxa.

Decapitation and Cremation: A Southeast Alaskan Burial Practice Reserved for Warriors Killed in Battle. J.D. IRISH, Department of Anthropology, University of Alaska Fairbanks, Fairbanks, AK 99775-7720.

An inventory of skeletal remains at the Alaska State Museum in Juneau yielded numerous biocultural data on historic and prehistoric Native peoples of Southeast Alaska. One of the more interesting finds concerns evidence for a mortuary practice that has, to date, received little attention in Northwest Coast literature.

Remains of three adult males, found in crevices or caves on south Admiralty and northern Kiui Islands, show signs of decapitation and post-cranial cremation. The first individual is represented by an intact skull and cremated post-crania. He died from massive head trauma; five wedge-shaped compression fractures, one of which penetrates the inner table, are present on his right parietal. The remains were found with a burial box -- although it was not recovered. The second individual consists of the same burned and unburned elements, albeit with no obvious trauma. A burial box was not part of the collection, although information on the recovery is sketchy. Finally, the third individual comprises a mummified head and cremated post-crania contained in a bentwood burial box; like the first case, he appears to have died as a result of trauma to the head. Radiocarbon dating of charcoal in the burned bone yielded a date of  $770 \pm 90$  BP (Beta-34185).

From the late prehistoric through historic periods in Southeast Alaska, cremation of the entire individual was the rule; the only well known exception involved shamans who, informants relate, can not be consumed by fire. What then was the explanation for the three sets of human remains? Early ethnographic accounts apparently provide an answer. Lisiansky (1814) and Niblack (1890) reported that to the north, Sitka-area Tlingit males killed in battle had their heads removed and bodies cremated for placement in separate burial boxes. Trauma on two of the three present specimens provides evidence of violence, if not confirmation of battle-sustained injuries. And, placement of head and post-crania in one rather than two boxes may simply reflect regional and/or temporal variation.

Research was made possible by the Chatham Area Forest Archeologist, Tongass National Forest, and the Alaska State Museum. The remains were repatriated, or their presence made known to affiliated groups.

Glenoid fossa depth and curvature as indicators of locomotor function in living hominoids and australopithecines. M. T. IRWIN, Doctoral Program in Anthropological Sciences, and S. G. LARSON, Dept. of Anatomical Sciences, SUNY Stony Brook, Stony Brook, NY 11794.

The work of many researchers has demonstrated the usefulness of scapular morphology in the identification of functional characters correlated with locomotor habits. While various aspects of the scapula have been studied, the depth and curvature of the glenoid fossa have largely been ignored, despite their obvious consequences for stability and mobility of the glenohumeral joint. The present study examines the depth and curvature of the glenoid fossa, in both supero-inferior (SI) and antero-posterior (AP) dimensions. The goals of this study were to investigate the utility of these features as indicators of locomotor function, and to apply them to the reconstruction of the locomotor mode of australopithecines.

Samples of moderns humans, *Pan*, *Gorilla*, *Pongo*, *Hylobates*, and *Papio* were analyzed for this study, as well as casts of two early hominids, AL-288-1L (*A. afarensis*) and STW 162 (*A. africanus*). Four

measurements were taken on each specimen: SI length, AP length, and depth of the glenoid fossa at the midpoint of each length. From these measurements, the radius of curvature and included angle of the arc defined by the glenoid's contour were determined in both the SI and AP directions. Spearman's rank-order correlations were examined in order to determine whether either scaled with body mass.

Included angles discriminated between broad taxonomic groups, but failed to sort humans and African apes, and therefore were not useful in inferring locomotor patterns of fossil hominids. Radius of curvature scaled with body size, and relative indices were constructed by dividing AP radius of curvature by SI, and by dividing each by glenoid size. These indices revealed that humans are distinct in displaying AP flattening of the glenoid compared to the great apes. The fossils clustered with the great apes, suggesting that australopithecines retain the primitive morphology.

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A Neanderthal child remains recovered at Dederiyeh cave, Syria in 1997-1998. H. ISHIDA, Department of Anatomy, Faculty of Medicine, University of the Ryukyus, Nishihara 903-0215 Japan, O. KONDO, Department of Anthropology, Graduate School of Science, The University of Tokyo, Tokyo 113-0033 Japan, SULTAN M. Direction General of Department of Antiquities and Museums, Damascus, Syria, and T. AKAZAWA, International Research Center for Japanese Studies, Kyoto, 610-1192 Japan.

In addition to the first discovery of a Neanderthal child in 1993, the partial skeleton of another child was recovered from the Middle Paleolithic layer at Dederiyeh cave, Syria in 1997-1998. The skeleton consists of an almost complete cranial vault, a partial facial skeleton including the mandible, bodies of vertebrae, right clavicle, left ilium, right and left femora, right and left tibiae, left fibula and other elements. The degree of dental calcification suggests an age around two years old.

The cranium and dentition display an array of anatomical features as a Neanderthal: slight appearance of the supraorbital torus, high and wide orbitae, strong concavity of nasal bones, long frontal process of the zygomatic bone, mid-facial prognathism, the presence of an occipital torus and suprainiac fossa or small pitting in the occipital bone, "En Bomb" cranial shape in norma occipitalis, the absence of a mental protuberance on anterior mandibular corpus and the presence of a medial pterygoid tubercle on the interior surface of the mandibular ramus, the presence of shovelling of the upper lateral permanent incisor, the presence of taurodontism in the lower first milk molar, T-shaped anterior fovea in the lower second milk molar and the presence of Carabelli tubercle in the upper second milk molar.

The lower limb bones show great anteroposterior curvature of the shaft and large dimensions in their extremities. From the proportion of the thigh to the



lower leg bones, it can be estimated that the child possessed relatively short legs.

The child skeleton is a Neanderthal sharing many morphological features with European Neanderthal children and is similar to the first Neanderthal child from Dederiyeh cave.

3D-kinematics of vertical climbing in apes. K. ISLER, Anthropological Institute, University of Zürich, CH-8057 Zürich, Switzerland

Vertical climbing is widely accepted to be the critical locomotion preadaptive to hominid bipedalism. However, empirical data about vertical climbing in nonhuman primates is scarce. The focus of this study is comparison of 3D-kinematics of vertical climbing in different species of hominoid primates in zoos. The climbing sequences are recorded simultaneously by four digital video cameras at a speed of 50 video fields/sec. The experimental setup is highly mobile and has no impact at all on the behavior of the animals. As studies on human locomotion reveal a high degree of variability between individuals as well as between different trials of the same individual, emphasis is laid on a sufficient number of individuals and trials, which allows to obtain reliable information on vertical climbing by a statistical analysis of the kinematic data. Angular displacement patterns of limb joints, cycle duration, stride length and gait pattern will be analysed. With the addition of segment mass data obtained from cadavers by segmentation, kinematic analysis will be extended to calculate the trajectory of the body center-of-mass and to estimate the forces imposed on the limb segments by inverse dynamic analysis. So far, more than 400 climbing sequences have been recorded of five individuals of western lowland gorillas (*Gorilla gorilla gorilla*) and of five individuals of white-cheeked gibbons (*Hylobates concolor leucogenys* and *H. c. gabriellae*). Preliminary analyses show substantial differences in footfall patterns and kinematics of vertical climbing between the two species, and allow to call into question qualitative descriptions of vertical climbing in the literature.

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Do theories of bipedalization stand up to anatomical scrutiny? N. G. JABLONSKI and G. CHAPLIN, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118-4599.

The adoption of habitual bipedal posture and locomotion was the key innovation responsible for the origin of human

lineage. Despite the critical importance of the origin of hominid bipedalism to the study of human evolution, direct evidence for the initial stages of bipedalization is lacking. Theories concerning the origin of hominid bipedalism have, therefore, relied on various sources of indirect evidence. Fortunately, relatively complete Plio-Pleistocene hominids such as AL-288 and KNM-WT 15000 provide direct evidence for the later stages of bipedalization, and their anatomies can be used to test predictions generated by theories concerning the origins of habitual bipedalism.

Among the most popular of current theories of the origin of hominid bipedalism are those which focus on the particular importance of feeding and carrying behaviors. In this study, we examined these hypotheses by comparing the anatomies of Plio-Pleistocene hominids with the hypothetical anatomies of hominids optimized for feeding or carrying. In terrestrial or semi-terrestrial mammals, adaptations to habitual bimanual feeding in shrubs and low trees have emphasized the development of forelimb length and strength, and of powerful shoulder retraction combined with truncal erectness and a low center of gravity, as seen in gorillas, giant ground sloths and chalicotheres. Anatomical optimization for bimanual feeding, thus, would not have involved bipedalism and is incompatible with the postcranial anatomy of Pliocene hominids such as AL-288. In those mammals (only catarrhines) in which manual carrying occurs during bipedalism, only light loads can be carried, and these for short distances only. Anatomical optimization for bipedal carrying in protohominids would have involved the enhancement of specializations (such as enlarged lumbar vertebral bodies) for weight transmission from the trunk to the lower limbs, and these are lacking even in earliest *Homo*.

We conclude that the anatomies predicted by the feeding and carrying hypotheses of bipedalization are incompatible with those known of Plio-Pleistocene hominids, and that the transition to habitual postural and, subsequently, locomotor, bipedalism was not initiated by selection for these behaviors.

Strategies for overcoming the current limitations on comparative genetic studies of the African Atlantic Diaspora. F.L.C. JACKSON<sup>1</sup>, K.M. JACKSON<sup>2</sup>, L.F. JACKSON<sup>1</sup>, S. KHAN<sup>1</sup>, L. HEYWOOD<sup>3</sup>, M. RASLAN<sup>1</sup>, X. JOHNSON<sup>4</sup>, R.A. KITTLES<sup>3</sup> (<sup>1</sup>University of Maryland, College Park, MD 20742; <sup>2</sup>MCP Hahnemann University, Philadelphia, PA 19129; <sup>3</sup>Howard University, Washington, DC 20060; <sup>4</sup>George Washington University, Washington, DC 20052)

The genetic reconstruction of the regional origins of the African Burial Ground population has been severely limited by the paucity of data on a broad spectrum of west African lineages and the virtual absence of genetic sequence data from central African lineages. As a result, significant gaps exist in the record of current genetic variability observed among indigenous ethnic groups of Angola, southwestern Congo, western Zaire, Equatorial Guinea, Sao Tome, Principe, Gabon, northern Namibia, and southeastern Mozambique. Also missing from our current repertoire are representative genetic lineages from northeastern Native American groups and genetic lineages from the eastern and southern Caribbean. This

presentation outlines the strategies needed for best reconstructing an AFRICAN AMERICAN ANCESTRAL GENETIC BANK from the most historically appropriate lineages among Africans, Europeans, and Native Americans.

The presentation also provides a strategy for best obtaining a geographically and historically representative proportional cross-section of contemporary African American genetic diversity. This sample would optimally be the basis for an AFRICAN AMERICAN GENETIC DATA BANK that could accelerate the search for haplotype correspondence between the African Burial Ground population and various contemporary African American regional groups. Timetables for the construction of these banks and the significance of these reference banks for a comprehensive interpretation African American history are highlighted.

Perceived work and home stress affect diurnally changing blood pressure levels differently in African American and Caucasian women. G.D. JAMES, Binghamton University-SUNY, NY 13902.

The levels and circadian patterns of variation of blood pressure (BP) among urban pre-menopausal women have been shown to be influenced by the varying stressfulness of diurnally changing microenvironments. The purpose of this study was to examine whether the impact of the perceived stressfulness of the work (W) and home (H) microenvironments on the patterns of daily BP variation was the same in African American (AA) and Caucasian (C) women employed in similar jobs at the same workplace. The subjects of this study were 29 AA (age=33.2±7.8; range 20.8 to 47.2 years) and 38 C women (age=35.4±7.4.5; range 18.2 to 49.3 years) who wore an ambulatory BP monitor over the course of one workday. BP averages were calculated every hour from 9AM to 6AM the next day. The stressfulness of the work (W) and home (H) microenvironments on the day of study was rated on a scale of 0 (low) to 10 (high). The pattern of hourly BP averages were compared between W-stressed (W>H stress; 11 AA and 20 C) and H-stressed (H ≥ W stress; 18 AA and 18 C) women within and between the ethnic groups. The results showed that among C women, those who were W-stressed had systolic BP's 8-11 mmHg higher than H-stressed women for every waking hour as well as most hours during sleep ( $p < .05$ ). Diastolic BP's were not statistically different, although the values of W-stressed women tended to be higher. In contrast, there were no significant differences in either systolic or diastolic BP between the W- and H-stressed AA women at any time during the day. The BP levels and patterns of variation of C and AA W-stressed women were similar, while, the H-stressed AA women had systolic BP levels 5-10 mmHg higher than the C women. These findings suggest that while stress specific to the W setting may increase high BP risk among C women, stress from any daily microenvironment may increase high BP risk among AA women.

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**Aging and the Genetics of Adiposity: Insights from 50 years of the Framingham Heart Study.**

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Long term epidemiology studies provide the opportunity to investigate the aging process in relation to many physiological systems. Recent trends to incorporate genetics into such studies further enhance the wealth of data by enabling investigation of the role of genetics in longitudinal processes such as aging. The Framingham Heart Study began in 1948 as a longitudinal epidemiology study. The original cohort consisted of 5,209 men and women, aged 28-62 years who were examined every two years and are currently age 78-100+ years. In 1971 The Framingham Offspring Study began with 5,124 men and women aged 5-70 years who were offspring of the original cohort. We used longitudinal data on body mass index (BMI) from the cohort and offspring to investigate (1) changes in heritability during the aging process, (2) heritability of change in BMI (estimated by linear regression) and (3) variability of BMI throughout adult life (35-65 years of age). We found that heritability decreases slightly after 40 years of age (from 0.47 at 40 years of age to 0.35 at age 60) and that covariates show age dependent effects on mean BMI. The change in an individual's BMI during adult life had a low, statistically non-significant heritability ( $0.13 \pm 0.07$ ). However, the within individual standard deviation of BMI during the interval 35-65 years of age showed significant heritability ( $h^2 = 0.24 \pm 0.06$ ). These results suggest that environmental factors act in an age specific manner on adiposity during the aging process. The finding that change in BMI was not heritable may reflect that changes in adiposity during aging can not be modeled in a linear fashion. However, the results do suggest a genetic component contributing to body weight stabilization throughout the adult life.

**Fetal development and evolution of the human posterior cranial fossa.** N. JEFFERY and F. SPOOR, Evolutionary Anatomy Unit, Dept. Anatomy and Developmental Biology, University College London, WC1E 6JJ, UK.

Compared with other primates, modern humans have more coronally orientated petrous bones and a higher degree of basicranial flexion. Studies have suggested that this condition results from a phylogenetic increase in the size of the cerebellum and ventral pons relative to the length of the posterior cranial base (Moss 1958; Dean, 1988). In order to elucidate the ontogenetic basis for such relationships, the hypothesis that petrous pyramid orientation and cranial base angle correlate with increases of relative infratentorial size during human fetal growth was investigated.

Forty formalin preserved human fetuses (53-205mm CRL) were imaged with high-resolution MRI. Infratentorial volumes were estimated as the sum of pixel areas below the level of the tentorium cerebelli. Cranial base angles and posterior cranial base lengths were computed using foramen caecum, sella, and basion. Petrous pyramid orientations were calculated as the angle between the antero-medial and postero-lateral attachments of the tentorium cerebelli to the petrous crests. Relative infratentorial sizes were computed as the cube root of subtentorial volume divided by posterior cranial base length.

Absolute infratentorial size increases by 23 times (360-8300mm<sup>3</sup>) over the gestational period studied and a significant increase of relative size was observed (cube root infratentorial volume vs. posterior cranial base length:  $r_{\text{rank}} = 0.907$  [ $P < 0.001$ ]; RMA slope = 1.23 [1.09-1.38, 95% conf. int.];  $n = 35$ ). This increase is not, however, significantly correlated with cranial base angle ( $r_{\text{rank}} = 0.033$  [ $P > 0.05$ ]) or petrous pyramid orientation ( $r_{\text{rank}} = 0.110$  [ $P > 0.05$ ]). These findings fail to corroborate the hypothesis that increases of relative infratentorial size are associated with an increase of petrous orientation and base flexion during the second trimester of human fetal development.

A measured approach to marks on bones.  
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Following the seminal work of Shipman (1981, 1983, 1986, 1988, 1989), a methodology is being developed to identify and describe marks made by people on bone during carcass processing using both qualitative and quantitative means. Quantitative means involve length and width measurements of marks and the number of actions that went into creating the mark. The focus of this presentation is on the statistical manipulation of the length and width measurements and the trends revealed, based on a database of over 200 measured marks. The initial approach uses univariate descriptive statistics and regression and ANCOVA to test for significant differences in the size and shape of marks. Significant differences are noted in the length and width of marks based on location, element, and type. Various mark types are discernible: a shorter group consisting of two clusters, one being composed of short and narrow marks and the other of short and broader marks; and a longer group consisting of long and broader marks. The groupings and fairly tight clusters indicate a consistency in mark sizes. A number of other consistencies are noted that indicates a regular or standardized way of producing marks in particular places on the bones and on particular elements. This procedure can be applied across time lines and prey species to

aid in identifying the early presence of people and examine their subsistence patterns.  
Supported in part by a grant from the National Science Foundation.

Paleoenvironmental analysis of an early Eocene locality in southwestern Wyoming. E.M. JOHNSON and R.L. ANEMONE. Department of Anthropology, Western Michigan University, Kalamazoo, MI 49008

Investigations in the Great Divide Basin of southwestern Wyoming during summer field seasons from 1994 through 1999 have yielded over four thousand specimens from various localities, ranging in age from the late Paleocene to the early Eocene. The most productive is Virgin Hills, an early Eocene (Wasatchian) locality characterized by many active anthills on a slope of fine grained, gray-green silty mudstone. Isolated teeth, mandibular fragments, and postcranial fragments of small mammals have been found in abundance on and around these anthills. The faunal list from Virgin Hills contains twenty eight taxa of various carnivores, creodonts, insectivores, perissodactyls, artiodactyls, rodents, condylarths, and primates. This paper offers a preliminary reconstruction of the paleoenvironment of this locality, based upon geologic and faunal evidence.

The lithology of Virgin Hills displays evidence as to the environment of the area during the early Eocene. The silty mudstone covering the locality suggests a low energy depositional environment, such as a floodplain or overbank deposit. The upper-most level of the section is a small, medium-grained, reddish sandstone. This indicates a higher energy depositional environment, such as a stream. Further geological evidence for the paleoenvironmental setting comes from a lignite layer near the bottom of the section, indicative of a well vegetated marsh or swamp.

Cenograms are rank order regressions of the estimated body weights of taxa from a locality. The parameters of these regressions enable researchers to infer the humidity and density of vegetation from the region. Application of cenogram analysis to the Virgin Hills fauna indicates that the region was a very humid open area such as a floodplain or marsh. The probable dietary preferences of the taxa from Virgin Hills, as inferred from their dentitions, lend further support to these findings.

The authors wish to thank the Wyoming Bureau of Land Management for their support of this project.

Circular shapes do not an ape make: Comments on interpretation of the inferred *Morotopithecus* scapula. K.B. JOHNSON, M.L. McCROSSIN and B.R. BENEFIT,  
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This paper examines the use of a rounded glenoid shape to both attribute a fragmentary scapular glenoid from the

early Miocene site of Moroto to the hominoid species *Morotopithecus bishopi*, and interpret its locomotor repertoire to be that of a suspensory climber (Gebo et al., 1997). To accomplish this, dimensions reflecting the shape of the glenoid cavity (height, width and depth) and observations about the size and shape of the acromion and coracoid processes were collected from a wide variety of eastern African mammals (including carnivores and artiodactyles) whose skeletons are housed in the Osteology Department of the National Museums of Kenya, as well as from extinct mammals from Miocene sites in Kenya. Data was analyzed using simple bivariate plots, regressions, indices and frequency data.

Cross taxonomic study shows that the glenoid cavity of eastern African mammals is impossible to categorize by shape alone. Several quadrupedal mammals reflecting a range of substrate preferences, including fast-running terrestrial animals such as impala, zebra, giraffe and *Climacoceras* share a rounded glenoid cavity. We conclude that glenoid shape is insufficient information to either attribute a fossil to a mammalian Order, or interpret its mode of locomotion.

In this study, all primate scapula were found to share long and thin acromion and coracoid processes that curve around the proximal humerus, and that are set in positions that do not occur among other living and fossil eastern African mammals examined in this study. Hence, identification of a fossil glenoid as primate can only be confirmed by the morphology of the acromion and coracoid processes, such as are not preserved on the purported *Morotopithecus* scapular fragment.

This study was supported by an NSF funded Research Experience for Undergraduate Award supplement to grant NSF-SBR-9505778 to Benefit and McCrossin, and an SIU Chancellor's Undergraduate Research/Creative Activity Award to K. Johnson.

**Baboon biogeography.** C.J.JOLLY Department of Anthropology, New York University, New York, NY 10003

Extant members of the genus *Papio* comprise a series of geographically-replacing, phenotypically distinct populations that are all, apparently, mutually interfertile and interbreed where they meet in nature. The conventional division into one, two or five species under-represents this diversity, both by leaving distinctive forms un-named, and by ignoring the existence of some broad clinal intergradations. All baboons are ecologically eclectic. The distribution of most recognizable forms does not map closely with ecological or vegetational zones, though boundaries may locally correspond to ecotones. The present-day biogeography of baboon forms shows some parallels to that of other non-forest animals, notably the vervet/grivet monkeys (genus *Chlorocebus*). This suggests that both taxa have responded to climatically-driven changes in vegetational distribution that established, and then

removed, barriers to the dispersal of savanna-dwelling primates. Current phylogeographic work, using genetic markers, is still relatively limited in scope, but is beginning to provide approximate dates for the divergence of baboon populations. Results to date point to even more complex histories than are documented by external morphology. The baboon example should caution against over-confident biogeographic and taxonomic interpretations of the fossil and genetic record of human evolution in Africa and beyond.

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**The functional characteristics of the ape foot musculature.** G.P. JONES, Department of Anthropology, Arizona State University, Tempe, AZ 85287-2402.

Estimates of relative masses are available for chimpanzee foot muscles and the functional pedal groups of apes (Sokoloff, 1972; Tuttle, 1970, 1972). While the maximum work potential ( $W_0$ ) of a muscle is directly proportional to its mass ( $M$ ), many researchers also use  $M$  to predict the maximum force potential ( $F_0$ ) and "functional importance" of a muscle. However,  $F_0$  is not directly proportional to  $M$  and a muscle may be designed more for displacement and velocity of shortening rather than for force production. The focus of this study was to: 1) estimate the  $W_0$ ,  $F_0$ , and maximum displacement ( $d_0$ ), and velocity of shortening ( $v_0$ ) potentials of the extrinsic and intrinsic foot muscles of apes; 2) examine the relationship between  $M$  and  $F_0$  in the foot muscles; and 3) examine how  $F_0$ ,  $d_0$ , and  $v_0$  are affected by muscle architecture.

The foot musculature of nine specimens from five ape genera was dissected.  $W_0$ ,  $F_0$ , and  $d_0$ - $v_0$  were assumed to be proportional to the  $M$ , relative physiological cross-sectional area ( $PCSA$ ), and mean fiber length ( $MFL$ ) of each muscle, respectively. Bivariate linear regression analysis was used to assess whether  $M$  alone can be used to reliably predict  $F_0$ . The relative degrees of specialization for force production ( $PCSA/M$ ) and displacement and velocity of shortening ( $MFL/L$ , with  $L$  = muscle length) were compared between muscles to help explain differences in their  $F_0$ ,  $d_0$ , and  $v_0$ .

Many similarities exist among the apes in the relative  $W_0$ s of their functional groups, but many differences are found in their relative  $F_0$ s due to differences in the architecture of their individual muscles. The hylobatid foot musculature is generally designed more for force production than the musculature of the great apes. Many of the orangutan's extrinsic muscles are designed more for displacement-velocity than those of the other apes. The foot muscles are less specialized toward either force production or displacement-velocity in the African apes, particularly in the chimpanzee whose  $F_0$ s are more reliably predicted from  $M$  alone.

Supported by a Research and Development Grant from the Department of Anthropology, Arizona State University.



Brain size and body size covariation in hominoids. W.L. JUNGERS, State University of New York, Stony Brook NY 11794, R.L. HOLLOWAY, Columbia University, New York NY 10027, W.T. FITCH, Harvard University, Cambridge MA 02138, and R.J. SMITH, Washington University, St. Louis MO 63130.

The covariation between brain size and body size is frequently assessed among species by the strength of the correlation coefficient, by the value of the slope of the log-log regression, and by measures of "relative brain size" derived from residuals (EQs) and/or ratios. Results and interpretations often depend on the methods selected and the nature of the comparative sample (e.g., wild-collected or captive). Here we re-examine the relationship between cranial capacity and body mass in the living hominoids and fossil hominids in several different ways, including the use of "phylogenetically independent contrasts" (PICs).

Our primary focus is on a sample of wild-collected apes with known masses (2 species of gibbon, the siamang, orang-utan, gorillas and chimps) and several modern human groups (e.g., African pygmies and the Danish sample). We first calculated the correlation coefficients and Model II regression slopes (RMA) for pooled sex-specific means and for single-sex samples without any adjustment for relatedness. We also calculated the same parameters for PICs using two evolutionary models (Brownian and "punctuated equilibrium") with males and females treated separately. Alternative equations are then used as "criteria of subtraction" to calculate EQs, including PIC baselines and a "metabolic" adjustment. Individuals are also plotted to create species-specific envelopes of brain-body covariation, and captive apes and fossil hominids are then added.

Choice of evolutionary model had a relatively minor effect on estimated slopes, but all PIC correlations are lower than unadjusted ones. Confidence intervals on all slopes are broad, but there was a consistent sex effect; whereas male PICs suggest negative allometry (as did unadjusted analyses), female PICs point instead to positive allometry. Not surprisingly, measures of relative brain size also varied depending on method and baseline, but rank order was frequently preserved. Simple ratios of brain to body size captured much of the same information.

**MtDNA Variation in New Guinea: Implications for the Peopling of the Pacific.** F.A. KAESTLE, D.A. MERRIWETHER, and J.S. FRIEDLAENDER, Departments of Anthropology, Yale University, P.O. Box 208277, New Haven, CT 06620; University of Michigan, 1020 LS&A Bldg., 500 S. State St., Ann Arbor, MI 48109; Temple University, Philadelphia, PA 19122

Over 300 individuals from the New Guinea Highlands and coastal plains, including more than 70 from Irian Jaya, have been typed for the presence of the mitochondrial 9 base-pair deletion, which has been

suggested as a marker for a recent wave of colonization of the Pacific Islands by Austronesian-speaking peoples. In addition, the mitochondrial hypervariable region I (HVSI) has been sequenced in more than 250 individuals from New Guinea.

Preliminary analyses of these data have suggested several conclusions. First, they have confirmed the almost complete absence of the 9 base-pair deletion in Highland groups, and have also shown this marker to be very rare in the populations from southwestern Irian Jaya. This supports the hypothesis that this marker was carried into the Pacific from Southeast Asia in a recent colonization event. Second, we have identified at least two additional mitochondrial haplogroups in New Guinea, especially common in the Highland groups, which might be representative of the oldest migration into New Guinea. Comparisons of the HVSI sequences from these haplogroups to those in the literature allow us to examine current hypotheses regarding the initial peopling of New Guinea. Third, preliminary analyses of our unpublished Australian sequences has shown little if any sharing of mitochondrial haplogroups with the New Guinea populations, which suggests that the separation between the two populations is quite ancient.

Parity effects on female body composition among Karimojong agropastoralists of northeast Uganda. M. KANG, S. J. GRAY, Dept. of Anthropology, University of Kansas, Lawrence, KS 66045. H.A. AKOL, Moroto, Uganda.

From August, 1998 through March, 1999, anthropometric examinations were conducted in southern Karamoja (Moroto District), Uganda, as part of an exploratory study of female fertility and its determinants among Karimojong agropastoralists. The Karimojong are a semi-nomadic population who have strong linguistic and cultural affinities with neighboring Turkana pastoralists, of Kenya.

308 Karimojong females were sampled, from four settlement clusters in Bokora and Matheniko territorial sections. They ranged in developmental age from puberty through the post-menopausal period (approximately age 15 through 70+ years). Anthropometric data include height and weight, calf and arm circumferences, 9 skinfolds (triceps, subscapular, suprailiac, para-umbilical, mid-calf, mid-axillary, mid-thigh, biceps, and forearm), as well as a number of measures of skeletal size. Additional information was collected on stage of pubertal development, reproductive status, gravidity, and parity.

We test two hypotheses concerning the relationship between adiposity and parity among Karimojong women: (1) the relationship between parity and fatness is significant, linear, and independent of age effects, and (2) there is an effect of parity on the distribution as well as the proportion of body fat. Post-menarcheal, nulliparous girls were assumed to have the highest percent body fat of females sampled and were used as the control group in analysis.

In previous research, adiposity of Turkana women was

found to decrease with increasing parity, and parity-related depletion of maternal fat stores also has been reported for other populations. Higher gravidity and parity may strengthen this association among younger Karimojong women. There also is some indication that both intensity and duration of breastfeeding are decreased among the Karimojong, relative to Turkana. Comparative study of Turkana and Karimojong women thus also may provide us with insight into differential effects on maternal energy balance of prolonged breastfeeding and moderate parity, versus curtailed breastfeeding and high parity, in two populations experiencing similar patterns of environmental stress.

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**The premenopausal potentiation of atherosclerosis and coronary heart disease (CHD): a hypothesis derived from observations on monkeys.** J.R. KAPLAN, S.B. MANUCK, Comparative Medicine and Anthropology, Wake Forest University School of Medicine, Winston-Salem, NC 27157.

The relative sparing of premenopausal women in comparison to similarly aged men is a prominent feature of atherosclerosis, the major pathologic process underlying the development of CHD. Although this phenomenon is sometimes referred to as "female protection", it is more accurately characterized as a delay in disease onset, with the incidence curve for women lagging behind that of men by about 10 years. Consequently, CHD is the largest cause of death in women over 50. Because atherosclerosis progresses over decades, it is likely that the clinical events occurring in peri- and postmenopausal women have their beginnings in the premenopausal years. This conclusion is supported by autopsy data showing that at least one-third of women has raised lesions in their coronary arteries by 35 years of age. Premenopausal cynomolgus macaques (*Macaca fascicularis*), like their human counterparts, are relatively resistant to coronary artery atherosclerosis in comparison to males. However, social subordination eliminates this "protection" from atherosclerosis in premenopausal animals. Social subordination also diminishes the number of normal, ovulatory menstrual cycles and reduces both periovulatory and average estradiol concentrations. Experimental manipulation reveals that the exacerbated atherosclerosis of premenopausal, subordinate monkeys can be completely inhibited by treatment with exogenous estrogen, proving that it is due to the socially induced ovarian suppression characteristic of subordinates. These data thus demonstrate that neuroendocrine factors contribute to vascular pathology – a long-standing hypothesis previously supported by little direct evidence. Furthermore, to the extent that these results reflect analogous processes in women – for example the presence of stress-induced ovarian impairment – the studies conducted in female monkeys highlight the potential importance of behavioral stressors in the development of atherosclerosis during the premenopausal period. Any such development would likely elevate the risk of postmenopausal CHD.

**eSkeletons:** a web-based platform for learning anatomical form and function.

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The utility of the web as a tool for learning and research is widely recognized, but its full potential for applications in physical anthropology remains to be realized. Recent advances in hardware and software now make it practical to scan and archive complexly shaped skeletal elements for inclusion in a digital library. We present here "eSkeletons" (<http://www.uts.cc.utexas.edu/~vskel/>), a web site that provides a digital library of the human skeleton. The site includes all of the separate elements from the human skeleton as 2-D images and 3-D animations, all with a text narrative that aids the user in learning how to identify the various elements and understand their functional significance. The user has the ability to navigate through the various regions of the skeleton, with views of six different orientations for each element, and the option to activate labels for muscle origins and insertions as well as joint surfaces. These images were captured with a high resolution digital camera. Three-dimensional data for each element were captured with either a 3-D laser scanner or by high resolution X-ray computed tomography (see <http://www.ctlab.geo.utexas.edu/>). These elements are available as either 3-D animations about a fixed axis, or as VRML animations, a plug-in that offers real-time 3-D control to the user. The site also includes 3-D animations of joint complexes, the option to download STL files as 3-D printouts, and self-quizzes. Chimp and baboon skeletons will be added to the site in the future. All of the materials on the web site will also be available on CD ROM.

The study of the skeleton is not an endeavor necessarily restricted to the professional physical anthropologist but is of wide interest to "K through Gray" learners. In order to facilitate the younger age group, the eSkeletons site contains a kid's portal. This portion of the site includes a series of exercises that can be downloaded for use in the classroom or at home on rainy weekends.

The universal availability of digitized holdings will greatly expand the reach of anatomy to encompass those students and instructors whose access to these materials is limited. Providing broad access to critical materials that are otherwise unavailable to students is one of the central goals of a digital library.

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**The effect of high temperatures, sunlight and low humidity on carrion decomposition in the Chihuahuan Desert.** R.N. KASSON, Department of Anthropology, New Mexico State University, Las Cruces NM 88003

In recent years forensic entomology has been recognized as a valuable tool for estimating PMI (post mortem interval) in many human forensic identification and recovery cases.

Previous Chihuahuan Desert Carrion studies have not been conducted for the purpose of human forensic application. Similarly research has been conducted in more temperate areas in different biotic zones that is not

directly applicable to arid desert environments. This research focused on establishing carrion insect composition and succession rates in the Chihuahuan Desert. A total of nine domestic swine (*Sus scrofa*) were used over the span of one year, three pig carcasses were sampled from for each 4 month period.

The results of this research suggest that high daytime temperatures, intense desert sunlight, low humidity and elevated maggot mass temperatures can create a fatal environment for Diptera during the summer months. Under the conditions encountered by other researchers working in more temperate areas, warm summer temperatures usually expedite the rate of decay. However, I have found that the decay rate will be accelerated until a maximum temperature is achieved, resulting in a mass die off of carrion fauna. This has the affect of nearly halting the decay rate by making the carrion unattractive to the next succession of insects. Also noted was the effect of opportunistic feeding by secondary predators, most notably lizards of the genus *Cophosaurus* on the numbers and composition of the carrion insect community. The feeding resulted in low numbers of Coleoptera which might lead to false PMI estimates.

This research was supported by the College of Agricultural Sciences, New Mexico State University.

Occipital condyle-atlas articulation congruence. C. KATZMARZYK, University of Toronto, Toronto, ON, M5S 1A1, and V.H. STEFAN, University of New Mexico, Albuquerque, NM 87131

In situations of mass disasters, criminal activities (intentional disarticulation), and in post-mortem events, an individual remains may become scattered or commingled. The forensic anthropologist may be called upon to address the concerns of minimum numbers of individuals and the association of elements from a single individual. In those cases of disassociation, the relationship of the cranium to the infracranial skeleton may be uncertain. This investigation is designed to determine the degree to which metric measurements of the atlas and occiput are correlated, determine if an atlas and cranium can be associated through morphometric analysis, and to determine if the morphometrics of the adjacent skeletal element can be predicted and to determine the accuracy of those predictions.

The study sample comprised 30 documented skeletons from the Maxwell Museum of Anthropology, University of New Mexico, of known age, sex and race. Twenty-four measurements, twelve measurement pairs of the atlas and occipital, measurements that were most likely to reflect joint congruence between the atlas and occipital, were utilized. These measurements document the morphology of the occipital condyles, foramen magnum, the vertebral canal and superior articular facets of the atlas. A canonical correlation (CANCORR) analysis was utilized to investigate the relationship between the measurements of the atlas with those of

the occipital. The results indicated that the correlations between the paired atlas and occipital measurements were strong. The first three canonical correlations were substantially larger than any of the occipital-atlas raw variable correlations (0.9976, 0.9841, 0.9659 respectively) and were significant ( $p < 0.001$ ,  $p < 0.001$ ,  $p = 0.0018$ ). These statistics indicated that the canonical correlation procedure was effective in identifying and describing the variation in the atlanto-occipital articulation and documenting the articulation congruence between the occipital and atlas. The canonical redundancy analysis of the CANCORR procedure showed that the first three canonical variables of the occipital and atlas may be adequate overall predictors of the opposite set of variables, with the proportions of the variance explained being 0.5657 for the occipital and 0.6082 for the atlas.

Familial resemblance in coronary heart disease risk. PT KATZMARZYK<sup>1</sup>, L PERUSSE<sup>2</sup>, T RICE<sup>3</sup>, J GAGNON<sup>2</sup>, JS SKINNER<sup>4</sup>, JH WILMORE<sup>5</sup>, AS LEON<sup>6</sup>, DC RAO<sup>3</sup>, and C BOUCHARD<sup>7</sup>. <sup>1</sup>York University North York, Ontario, <sup>2</sup>Physical Activity Sciences Laboratory, Laval University, Ste-Foy, Québec, <sup>3</sup>Washington University Medical School, St. Louis, MO, <sup>4</sup>Indiana University, Bloomington, IN, <sup>5</sup>Texas A & M University, College Station, TX, <sup>6</sup>University of Minnesota, Minneapolis, MN, <sup>7</sup>Pennington Biomedical Research Center, Louisiana State University, Baton Rouge, LA.

The purpose of this study was to quantify familial resemblance in coronary heart disease (CHD) risk in 260 black and 427 white participants from the HERITAGE Family Study. CHD risk was estimated using a coronary heart disease risk index (CHDRI) computed from an algorithm of the Framingham Heart Study, based on age, LDL-cholesterol, HDL-cholesterol, blood pressure, diabetes, and smoking status. Using a familial correlation model to test hypotheses regarding familial aggregation, significant familial resemblance in blacks and whites was detected for the CHDRI, both before and after adjustment for age. Parent-offspring resemblance was seen only in the white sample for the unadjusted CHDRI, while there were significant sibling correlations in blacks for both the age-adjusted and unadjusted CHDRI, and in whites for the age-adjusted CHDRI. There were significant spouse correlations for the unadjusted CHDRI; however, spousal resemblance was lower after age-adjustment. The maximal heritabilities were 37% and 34% in whites, and 68% and 53% in blacks, for the unadjusted and age-adjusted CHDRI, respectively. Thus, the maximal heritability, which includes both genetic and nongenetic sources of variation, is higher in blacks than whites, and explains a significant proportion of the total phenotypic variance. The results indicate that risk of CHD runs along family lines, and common environmental effects are important in explaining the observed familial resemblance.

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Ecological zones and the visual system: the human visual pathway reflects an arboreal ancestry. JASON A. KAUFMAN, Department of Anthropology, Washington University in St. Louis, MO 63130.

A highly acute visual system adapted for stereoscopic color vision is a distinguishing feature of the Primate Order. The primate reliance on visual acuity has been primarily examined through gross craniofacial morphology, examples of which include the presence of a post-orbital bar and frontation of the orbits. Comparatively less attention has been paid to the neurological properties of the visual pathway on a histological scale.

Quantitative data on the number of axons comprising the optic nerve, of retinal-ganglion cells in the neural retina, and peak (foveal) retinal-ganglion cell density were collected from the literature for vertebrate species encompassing a diverse taxonomic and ecological range. Comparative analysis shows that variation in these neural properties of the visual pathway is strongly related to the ecological zone in which a species lives. Arboreal and aerial organisms exhibit the highest number of cells and the greatest density of retinal-ganglion cells at the fovea.

It has been previously demonstrated that retinal-ganglion cell number and density relate directly to visual acuity. The spatial and visual complexity of the environment in which an organism operates, and the consequent selection pressures acting on the visual system, constitute the most likely explanation for variation in the neural properties presented here.

Finally, the visual pathway of humans and baboons – both terrestrial primates – exhibit a histological pattern that is identical to squirrels and arboreal primates. It is suggested that the histological properties of the human visual system are a reflection of our arboreal ancestry.

Giving voice to the vanished peoples of Newfoundland using ancient DNA. T.A. KEELS, Dept. of Biology, Ball State University, Muncie, IN 47306, [takeels@prodigy.net](mailto:takeels@prodigy.net); and G.A. PEARSON, Dept. of Anthropology, University of Kansas, Lawrence, KS 66045, [ftgap@eagle.cc.ukans.edu](mailto:ftgap@eagle.cc.ukans.edu).

The death of the last Beothuk Indian of Newfoundland in 1829 left many unanswered questions regarding their origins, language, culture, and overall affinities with neighboring Native groups. Their place and role in the prehistory of North America is often overlooked or even ignored due to a lack of information. Early ethnohistorical accounts describe the Beothuk as distinct both linguistically and phenotypically from Inuit and Algonquian groups of the mainland. However, no one knows who the Beothuk really were and their origins continues to be a matter of speculation.

To remedy this situation DNA was extracted

from dentin belonging to a prehistoric individual in order to test against known haplotypes found in Native American populations. Genetic comparisons between Beothuk and Algonquian Native groups are used to determine possible relationships and if a population split occurred. Tests also examined if the Beothuk experienced a dramatic founder effect once they occupied the island of Newfoundland. This study used the new Adapter Attachment and Amplification method (AAA). This approach is useful for amplifying the genome in a reasonably representative way from small amounts of starting material using standard PCR-based methods and analyzing rare, archival and ancient samples without exhausting irreplaceable material. This procedure leads to greatly improved efficiency in the collection and use of rare genetic samples.

Thanks to recent advances in aDNA analysis we hope to finally incorporate the Beothuk Indians into their rightful place among other New World populations.

This research was supported by Sigma Xi, and Ball State Internal Grants with assistance from the National Museum of Scotland.

A preliminary affinity analysis of crania from the New York Burial Ground. S. KEITA, K. SHUJAA, New York African Burial Ground Project, Department of Sociology and Anthropology, Howard University, Washington, DC 20059

The New York African Burial Ground is an eighteenth century cemetery in New York City. Historical records indicate it was primarily a place of burial for enslaved Africans and their descendants. Mortuary evidence suggests that some of the grave occupants may have recently come from Africa. Male crania (n=28) from the site were studied as a group using metric variables and canonical discriminant functions in order to attempt to obtain a sense of possible regions of origin, understanding the inherent difficulties in this enterprise. Ten traditional measurements were employed. The relatively sparse relevant comparison material included remains from other regional colonial groups, and African regions known to have been departure points for victims of the transatlantic slave trade, as well as the Howells' data base. The first two functions accounted for 54% of the variance. A plot of centroid values on functions I and II shows the New York African Burial ground crania to be roughly equidistant to material from Ghana, west central Africa and South Africa (Zulu), and further removed from Malian (Dogon) and Kenyan (Teita) series. The first two are regions known to have been involved in the transatlantic slave trade. Other colonial era material from New York did not plot near African series.



Identification of a birth cohort in the Miocene hominoid fossil record. J. KELLEY, Department of Oral Biology and C. BULICEK, Department of Anthropology, University of Illinois at Chicago, Chicago, IL 60612.

One of two hominoid species from the Middle Miocene site of Paşalar, Turkey is represented by nine upper central incisors from seven or eight individuals. All incisors display an essentially identical pattern of two distinct hypoplasias on the same portion of the labial crown face. The two hypoplasias differ from one another uniformly on all of the teeth in terms of depth and duration. The distance between the hypoplasias is also the same on each of the teeth, confirmed by consistent perikymata counts between hypoplasias on several of the specimens.

The striking similarity in the morphologies and durations of the two hypoplasias among individuals, and the uniform distance between them, strongly suggest that the hypoplasias were produced by the same two stressful episodes in all of the individuals. The virtually identical locations of the hypoplasias on all tooth crowns reveal that each of these individuals was at approximately the same maturational stage when these episodes occurred. We infer, therefore, that these individuals represent a single birth cohort and that the species exhibited birth seasonality. The alternative explanation, that the hypoplasias represent stressful episodes from different years, would require essentially exact coincidence in the intensity, duration and timing of the hypoplasia-causing events from year to year. This is at least possible in habitats with highly regular seasonality. In this case, the perikymata counts between the hypoplasias would indicate an approximately semi-annual periodicity. Since there is sufficient space between the incisal edge and the first hypoplastic line on all teeth for there to have been another hypoplasia if the periodicity was six months, such periodicity is not indicated.

We therefore conclude that the eight individuals do represent a single birth cohort and that all were born within a relatively short span of time, consistent with birth seasonality. Furthermore, all have virtually the same minimal degree of wear, indicating that these individuals died at approximately the same age and, presumably, at the same time. This last attribute will be explored in light of the taphonomy at Paşalar.

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The question of speciation in *Homo erectus* revisited I: the metric evidence. J H KIDDER and A C DURBAND. Department of Anthropology, University of Tennessee, Knoxville, TN 37996-0720

The hominid fossil taxon *Homo erectus* has recently come under scrutiny and it is currently thought by some that the variation seen in many of these Middle Pleistocene hominids warrants specific designation. This has led to the formation of controversial taxa such as *Homo ergaster*. This investigation assesses the question of speciation from a metric perspective.

Fifteen *Homo erectus* crania are partitioned into geographical and temporal groups. These include ER 3733 and ER 3883 from Africa; Zhoukoudian III, X, XI, and XII from China; Trinil 2, Sangiran 2 and 17

from the early East Asian horizons; and Ngandong 1, 5, 6, 10, 11 and Sambungmacan from the late East Asian horizons. Ten cranial vault measurements are taken from original specimens, casts of the individuals or from the literature.

Using the W.W. Howells anatomically modern human data set to derive a pooled within-group covariance matrix, Mahalanobis Distances are calculated on principal components of shape between each pair of fossils to determine their morphometric similarity. Significance level is assessed by comparing each fossil distance to a range of distances created by a random pairing of all Howells crania. If the actual fossil distance is beyond the 95% confidence level of the range of randomized Howells distances, the two fossil crania are significantly different in shape.

The results of this study reveal that evidence of significant separation between the regional samples of fossils exists. This strongly suggests that multiple groups, perhaps species, exist within the group of Middle Pleistocene fossils traditionally considered *Homo erectus*. This study corroborates the companion study on the non-metric traits of these crania as well as previous work by each of the authors.

The Broome County Poor House: Berated, Bound Out and Buried. KILLORAN, P.E., TARRICONE F., O'BRIEN, T.

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Nineteenth century New York State poor farms reflect urban and national growth and aid our understanding of these biocultural interactions. Poor house statistics echo societal values and institutional practices. New York's growth influenced national policy. The 1870 census refers to N.Y. poor farms as a model for reducing the cost of the care of the poor, but it also indicates the difficulty of discerning temporary relief from criminal pauperism. New York when compared to Pennsylvania had a greater number of pauper laws and higher numbers of criminal paupers. Broome County Poor House research provides insights to this system. The Poor House in Broome County was designed to be a self sufficient entity which would put an end to the practice of auctioning off debtors to the lowest bidders, known as bounding out. Relief from debt came by publically swearing one's self as a debtor and surrendering one's rights to the guardianship of the poor house. Data from the local newspaper as well as drawings from historical archives provide the historical context for the intent of the superintendents, fulfilling the Victorian work ethic and sense of economy. This will be

contrasted with Superintendent's Records from 1831 to 1877 which show the continued practice of bounding out, high rates of death and large numbers of discharges as the population grew.

**Microsatellite repeat size differences between populations or species: role of ascertainment bias.** M. KIMMEL, R. CHAKRABORTY, R. E. FERRELL, and R. DEKA. Statistics Dept., Rice University, Houston, TX; Human Genetics Center, Univ. Texas School of Public Hlth., Houston, TX; Dept. Human Genetics, Univ. Pittsburgh, Pittsburgh, PA; and Dept. Environmental Health, Univ. Cincinnati, Cincinnati, OH.

Ascertainment bias of inter-species (population) studies of microsatellite loci occurs when a locus is selected based on its large allele size in one species, in which it is first discovered (say, the cognate species 1). This bias is reflected in average allele length in any non-cognate species 2 being smaller than that in species 1. This phenomenon was observed in various pairs of species, including comparisons of allele sizes in human and chimpanzee. Various mechanisms were proposed to explain the ascertainment bias. Here, we examine the simplest possible framework: A single-step asymmetric and unrestricted stepwise mutation model with genetic drift. The model is analyzed based on coalescence theory. The mechanism of ascertainment bias in this model is a tighter correlation of allele sizes within a cognate species 1 than of allele sizes in two different species 1 and 2. We present computations of the expected bias, given the mutation rate, population sizes of species 1 and 2, time of separation of species 1 and 2, and the age of the allele. In particular, using the coalescence theory, we show that when the past demographic history of the cognate and non-cognate taxa are different, the rate and directionality of mutations will impact the allele sizes in the two taxa differently than the simple effect of ascertainment bias. Allele-frequency data on 8 human-specific and 6 chimpanzee-specific CA-repeat loci, studied in humans and chimpanzees, are shown to be in general agreement with these theoretical predictions of ascertainment bias. (Research supported by NIH grants GM 41399, GM 45861 and GM 58545).

Evidence of paleopathology in the Anasazi and Mogollon cultures derived from the Paul S. Martin osteological collection. E.H. KIMMERLE, University of Tennessee at Knoxville, TN 37996, and S.E. NASH, The Field Museum, Chicago, IL 60605.

Eight archaeological sites from New Mexico, Arizona, and Colorado,

representing the Anasazi and Mogollon cultures, were arbitrarily chosen from the Paul S. Martin osteological collection, curated at The Field Museum in Chicago, IL. Over 100 burials and a minimum number of 106 individuals are represented. First, the size, history, preservation, and scientific value of the collection are discussed. Second, recently proposed hypotheses that warfare and cannibalism were common practices in these cultures are addressed based on the archaeological and physical evidence present in this collection. Moreover, shifts in subsistence patterns and technology throughout this period provide an explanation for temporal differences in the nature and prevalence of infectious and nutritional diseases, anti- and peri-mortem trauma, and activity related skeletal changes. This investigation further demonstrates the Paul S. Martin collection provides a wealth of information regarding disease, subsistence, and cultural practices in Southwestern antiquity.

**Phylogenetic information content of ontogenetic sequences.** S.J. KING, Department of Anthropology, University of Massachusetts, Amherst, MA 01003

Interest in the relationship between primate ontogenies and evolution has frequently focused on the analysis of metric data, e.g. on evolutionary changes in relative growth. Less attention has been given to interspecific variation in the order of occurrence of ontogenetic events. Outside of primatology such sequence data have increasingly been the subject of evolutionary studies. Using ontogenetic series of 12 primate species (*Gorilla gorilla*, *Pan troglodytes*, *Hylobates lar*, *Macaca fascicularis*, *Lophocebus albigena*, *Cercopithecus ascanius*, *Trachypithecus cristatus*, *Nasalis larvatus*, *Saimiri sciureus*, *Saguinus nigricollis*, *Perodicticus potto*, and *Propithecus verreauxi*) representing 7 families, I scored the developmental status of 72 dental, cranial, and postcranial traits to reconstruct species-typical ontogenetic sequences.

Despite the superficial commonality of ontogenetic sequences among even distantly related primate species, the order in which teeth erupt, epiphyses fuse, and sutures close contains a large amount of phylogenetic information. A discriminant function analysis of developmental events reveals significant differences among taxa, such that families--and frequently genera--can be discriminated based solely on sequence data. In a study of hominoids and cercopithecoids, for example, the first discriminant function clearly separates the two superfamilies and the second discriminant function

distinguishes the hylobatidae from the hominidae. The degree to which taxa can be distinguished increases at higher taxonomic levels. I use this information to identify interspecific ontogenetic commonalities, and where in primate phylogeny particular developmental patterns or innovations first appeared.

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Growth disruption and linear enamel hypoplasia in a population of known age and sex. T. KING<sup>1</sup>, S. HILLSON<sup>2</sup> & L.T. HUMPHREY<sup>1</sup>. <sup>1</sup>Human Origins Group, Department of Palaeontology, The Natural History Museum, Cromwell Road, London SW7 5BD, U.K. <sup>2</sup>Institute of Archaeology, University College London, 31-34 Gordon Square, London WC1H 0PY, U.K.

Archaeological collections of human remains represent death assemblages that can be used to address issues of health and longevity in the past. There is increasing evidence from studies of both living and past human populations to suggest that stress suffered during early life can result in poor adult health and a shortened lifespan. Using enamel hypoplasia as an indicator of growth disturbance, we have examined the relationship between incidence of linear (furrow-form) hypoplasia and subsequent health life expectancy in a sample of 18th and 19th century individuals of known age at death and sex from the crypt of Christ Church, Spitalfields.

Although enamel hypoplasia has been widely used as an indicator of systemic stress in a variety of applications, most previous studies have been based on simplified models of tooth crown development. Our analysis relates furrow-form defects to incremental growth structures on the surface of the tooth crown, following recent work by Hillson & Bond. This non-destructive technique provides detailed information about the age of occurrence and the duration of an episode of growth disturbance. We examined linear enamel hypoplasia in the permanent teeth. For each individual, growth disruptions were matched across different tooth classes which overlap in their developmental schedule, representing enamel growth from approximately 1 year of age until approximately 7 years of age. Most individuals studied in the collection display several furrow-form defects which vary in duration, indicating that they suffered recurrent episodes of growth disturbance during early life. These growth disruptions are related to other indicators of stress in the skeleton and dentition.

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Diets of Fayum primates based on molar shearing crest analysis. E.C. KIRK and E.L. SIMONS, Biological Anthropology and Anatomy, Duke University Medical Center, Durham, NC 27710.

Over the last 90 years, Eocene and Oligocene aged sediments in the Fayum Depression of Egypt have yielded at least 17 distinct genera of fossil primates. However, of this considerable sample, the diets of only 4 early Oligocene anthropoid genera have previously been inferred using quantitative methods. Here we present dietary assessments for 11 additional Fayum primate genera based on the analysis of body mass and molar shearing crest development.

For the purposes of this study, body mass was estimated using M<sub>2</sub> area. Molar shearing capacity was measured by calculating shearing quotients (see Kay and Simons, IJP 1:21-37). We judged species with poorly-developed molar shearing to have been primarily frugivorous or gummivorous, and species with relatively well-developed molar shearing to have been folivorous or insectivorous. Body mass was used to distinguish folivores from insectivores.

Our analysis reveals that anthropoids from late Eocene Fayum localities were predominantly frugivorous. The only exception is *Catopithecus*, which probably consumed leaves supplemented by a large proportion of fruit. Late Eocene Fayum prosimians exhibited a diversity of dietary habits, including specialized insectivory (*Anchomomys*), generalized frugivory (*Plesiopithecus*), frugivory + insectivory (*Wadilemur*), and strict folivory (*Aframomys*). By contrast, early Oligocene Fayum localities are overwhelmingly dominated by frugivorous anthropoids, and appear to have lacked prosimians that occupied folivorous niches. These differences between the trophic specializations of anthropoids and prosimians in the Eocene and Oligocene Fayum samples probably reflect the modernization of continental African primate communities across the Eocene-Oligocene boundary. Furthermore, evidence that sympatric prosimians and early anthropoids jointly occupied frugivorous and folivorous feeding niches during the late Eocene reinforces the conclusion of Rasmussen and Simons (IJP 13:477-508) that the primary ecological impetus for the origin of the Anthropoidea did not involve novel dietary adaptations.

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From African to African American, insight on the formation of African American mtDNA variation. R.A. KITTLES<sup>1</sup>, M. Doura<sup>1</sup>, N. Sylvester<sup>1</sup>, F.L.C. JACKSON<sup>2</sup>, and M. BLAKEY<sup>1</sup>, <sup>1</sup>Howard University, Washington, DC 20060; <sup>2</sup>University of Maryland, College Park, Maryland 20742.

The African American gene pool is highly heterogeneous due to the historical intermixture of various indigenous African populations and gene flow from non-African populations. Very little genetic information is known about Africans in early America which is why genetic analyses of archeological sites such as the African Burial Ground in New York City are of immense anthropological importance. Following its discovery in New York City, archeologists excavated over 400 skeletal

remains and associated artifacts, primarily of Africans who died during enslavement. The genetics of the African Burial Ground population has provided insight not only in the initial development of the African American gene pool but also in indigenous African genetic variation.

Here we examine mitochondrial DNA control region sequences from 54 individuals from the burial ground and 75 contemporary African Americans from New York City and Columbia, SC. mtDNA sequences were compared to published data from African, European and Native American populations. Both the burial ground and contemporary African American population exhibited high mtDNA diversity consistent with other samples of African origin. Phylogenetic analysis revealed that 60% of the burial ground samples clustered with haplogroup L2 which is common in the Senegambia and Gold Coast of Africa. In addition, an appreciable number of haplotypes (15%) belong to haplogroup L3 which is common but not restricted to the Eastern and Horn region of Africa. The remaining mtDNA haplotypes clustered with the L1 haplogroup common among Central and Southern Africans. The sample of contemporary African Americans revealed a similar pattern of mtDNA variation however two haplotypes from the Amerindian haplogroup B were also observed.

While it is clear that large gaps exist in genetic samples from Africa, it is also likely that these gaps contribute to a regional demarcation of African genetic variation. A well defined survey of African mtDNA variation may identify the distribution of pan-African haplotypes. For example, the mtDNA L1 haplogroup is poorly defined due to the limited sampling of indigenous African populations (especially from Angola, Mozambique and Madagascar). Because of this limited sampling and recent gene flow within Africa, the exact geographic or ethnic origin in Africa of a majority of the Burial Ground samples is difficult to determine.

Testosterone and behavioral differences in fully developed and undeveloped wild Bornean orangutans (*Pongo pygmaeus pygmaeus*). C.D. KNOTT, Department of Anthropology, Harvard University, Cambridge, MA 02138.

Intriguingly, it has been proposed that there may be two types of fully "adult" male orangutans. Developed males have larger bodies, produce "long calls", and exhibit secondary sexual characteristics such as cheek flanges. Undeveloped males retain a smaller, "sub-adult" size morphology and do not exhibit these secondary sexual characteristics. Some of these small males may just be in transition before full maturation. Other males seem to remain longer in an undeveloped stage. Males have been reported to still be "sub-adults" at an estimated age of 20 years in the wild and up to 18 years in captivity. This study presents the first data from the wild on differences in testosterone levels between these two classes of adult male orangutans. The research was conducted in Gunung Palung National Park, Indonesian Borneo. It is based on over 25,000 observation hours between 1994 and 1998.

Morning urine samples were collected regularly from developed and undeveloped males and preserved through drying on filter paper. Testosterone levels were measured using radioimmunoassay. Results show that undeveloped males have significantly higher testosterone levels than do fully developed males.

These results are compared to those from captivity where Maggioncalda *et al.* (1999) also found that those males in the process of developing had higher testosterone levels than did fully developed males. Captive studies indicate

that these undeveloped males appear to have adequate production of testosterone and are fully capable of fathering offspring (Kingsley 1982, 1988).

Several studies, including this one, have shown that undeveloped males appear to engage in more forced copulations, and more overall copulations than do fully-developed adult males. In contrast, developed males are more territorial and more likely to engage in lethal aggression. The implications of these behavioral and hormonal differences for interpreting male strategies are discussed.

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Inheritance of body size in rhesus macaques from Cayo Santiago. L. A. P. KOHN, Washington University, St. Louis, MO, J. E. TURNQUIST, M. J. KESSLER, and J. BERARD, Caribbean Primate Research Center, University of Puerto Rico, Puerto Rico.

Inheritance of phenotypic traits is important in the understanding of the trait's evolution. Inheritance of body size has been widely studied among human populations, but few studies have examined these traits in nonhuman primates. This study examines the inheritance of body size and corresponding skeletal dimensions in free-ranging Cayo Santiago rhesus macaques (*Macaca mulatta*).

Twelve body dimensions were measured in the field on 82 adult male and 124 adult female rhesus macaques. All individuals were of known age, and represent 14 matrilineal lines of 2 to 37 individuals. Skeletal dimensions were available on a subset of 15 male and 29 female individuals. Mother-offspring regression and maximum likelihood methods were used to estimate the body dimension heritability. Correlation between body size and skeletal dimensions estimates the relationship between measurement on live individuals and subsequent skeletal material.

Most body dimensions are significantly heritable, with an average heritability of 0.62. Mother-offspring regression and maximum likelihood methods produce similar heritability estimates, however greater significance is available with the maximum likelihood methods which utilize more individuals. Body size and skeletal dimensions are not significantly equal, but they are significantly correlated. Significant genetic variation is available in the Cayo Santiago rhesus macaques, and skeletal dimensions provide a good estimate of the body dimensions of individuals.

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